

we report on extremely high yield of 25% of the dark state observed for the yellow-emitting Ag nanoclusters formed on calf thymus DNA [3]. This result seems to be promising in further creating polymer-stabilizing Ag nanoclusters with specially designed structure providing high efficiency of the dark state formation.

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[2] Richards, C. I.; Hsiang, J.-C.; Senapati, D.; Patel, S.; Yu, J.; Vosch, T.; Dickson, R. M. Optically Modulated Fluorophores for Selective Fluorescence Signal Recovery. *Journal of the American Chemical Society* 2009, 131 (13), 4619-4621.

[3] Volkov, I. L.; Ramazanov, R. R.; Ubyvovk, E. V.; Rolich, V. I.; Kononov, A. I.; Kasyanenko, N. A. Fluorescent Silver Nanoclusters in Condensed DNA. *ChemPhysChem* 2013, DOI: 10.1002/cphc.201300673.

Biophysics Education

1096-Pos Board B851

"A Physical Lens on the Cell": Beginnings of a Free Online Book on Sub-Cellular Biophysical Processes for Students from Heterogeneous Backgrounds

Daniel Zuckerman.

University of Pittsburgh, Pittsburgh, PA, USA.

Biophysical principles are central to cell biology, but typical biophysics books are physics-centric and equation-heavy. Such specialized presentations can be a significant barrier to biology-trained students and perhaps even for physics students in that key concepts may be obscured by intimidating formalism. "A physical Lens on the Cell" (PLoC) is a new online book which takes the perspective that most of the essential physics underlying cell biology can be understood from relatively simple principles, primarily a mass-action/kinetic picture of non-equilibrium processes. This perspective enables straightforward explanation of a wide range of phenomena including: (free) energy storage by activated carriers and in gradients; the operation of molecular machines such as motors and pumps; phosphorylation processes; and enhanced genetic information transfer in proofreading processes. The hyperlinked structure of PLoC enables students from varying backgrounds to design their own study pathways through the material, which ranges from qualitative to semi-quantitative to fully quantitative. PLoC also attempts to organize the vast world of cell biology within a physical hierarchy: chemical physics, molecular processes, the energy economy, etc. PLoC is very much a work in progress, but is publicly available: <http://www.csb.pitt.edu/Faculty/zuckerman/html/start.html>. The site's interface permits side-by-side reading of pages for ready cross-referencing and access to other content.

1097-Pos Board B852

Introductory-Level Course on Randomness and Order in Soft and Biological Matter

Elon Langbeheim¹, Shelly Livne¹, Nava Schulman¹, Ruth Chabay², Sam Safran¹, Edit Yerushalmi¹.

¹Weizmann Institute of Science, Rehovot, Israel, ²North Carolina State University, Raleigh, NC, USA.

Explanations of the spontaneous assembly of molecules into mesoscopic (nanometric) or micron-sized structures that are important in biological cells (i.e. membranes, polymers, and colloids), require an understanding of cooperative behavior in interacting, multi-particle systems. We present a conceptual and quantitative framework for teaching these phenomena to introductory-level students, which was tested in a pilot interdisciplinary course given to advanced (AP level) high school students in Israel. We first discuss the competition of configurational entropy (that leads to randomness) and interparticle interactions (that leads to structure formation) in terms of a lattice model in the context of binary mixtures. The lattice model, which allows for simple calculation of both entropy and interactions also provides a concrete visualization of the particles comprising the system; it is used in the statistical thermodynamics via free energy minimization. Our approach is then used to model the mesoscale structure and macroscopic phase separation of fluid mixtures and the resulting interfaces, polymer solutions, and the self-assembly of lipids¹. Parts of the curriculum can be incorporated into re-structured introductory physics courses for life sciences, allowing students to understand how the competition between interactions and entropy is resolved in the formation of mesoscopic structures. The course is also beneficial for physics and chemistry students since it provides them with insight and quantitative examples of strongly interacting, many-particle systems; this is in contrast to the one-particle systems that are typically the focus of introduc-

tory physics courses. The syllabus can also form part of an integrated, quantitative science course which can be presented at the introductory level since it does not require advanced mechanics, electromagnetism or quantum mechanics.

¹ E. Langbeheim, S. Livne, S. A. Safran, E. Yerushalmi, Introductory physics going soft.

American Journal of Physics, **80**, pp. 51-60, 2012.

1098-Pos Board B853

Teaching Physics at San Quentin State Prison: Year 2

Troy A. Lionberger, Diane M. Wiener, Samuel M. Leachman, Frank Chuang, Sam Tia, Cory Antonakos, Carlos J. Bustamante. University of California, Berkeley, Berkeley, CA, USA.

In the United States, prisoners earning an associate degree while incarcerated are nearly 50% less likely to reoffend within three years of release than those who did not participate in college-level educational programs. Along these lines, several studies have shown that postsecondary education can be one of the least expensive and most effective ways to reduce the likelihood that ex-offenders return to prison. And yet, most states do not offer publically financed, on-site educational opportunities for incarcerated persons. At last year's Biophysical Society Meeting, we introduced a college-level, physics laboratory course we taught during the Summer 2012 semester at San Quentin State Prison through the Prison University Project. The course was designed by graduate students and postdocs who volunteered at night and on weekends to teach as part of a continuing outreach effort intended to provide free, high-quality instruction to the general prison population. Our goal was to provide an opportunity for students to get transferable credit for a lab-based science course, which will be required for eventual transfer upon release into a four-year state college in California. Here, we present an update on our course, now in its second year and taught during the Fall 2013 semester. We discuss changes to the course design implemented to better serve the student population and to adapt to the unique teaching environment at San Quentin. The second version of the course was underway at the time of abstract submission, but the initial assessment was promising: student performance was improving, the drop rate decreasing, and the course more effectively addressed the diverse educational backgrounds of our students. We will present the results of our ongoing efforts teaching physics at San Quentin, including the outcomes of students who took the course the first time.

1099-Pos Board B854

Biophysics in the Undergraduate Curriculum

Peter H. Nelson.

Physics and Biology, Benedictine University, Lisle, IL, USA.

Recently there have been multiple calls for curricular reforms to develop new pathways to the science, technology, engineering and math (STEM) disciplines. In response, I propose a conceptual framework for quantitative scientific modeling skills that are useful across all the STEM disciplines. The approach actively engages students in a process of directed scientific discovery using Monte Carlo simulations and finite difference methods using the "Marble Game" as a model system. In a "Student Assessment of their Learning Gains" (SALG) survey, students identified this approach as producing "great gains" in their understanding of real world problems and scientific research. Students build a conceptual framework that applies directly to random molecular-level processes in biology such as diffusion and interfacial transport. It is also isomorphic with a reversible first-order chemical reaction providing conceptual preparation for chemical kinetics. The computational and mathematical framework can also be applied to investigate the predictions of quantitative physics models ranging from Newtonian mechanics through RLC circuits. To test this approach, students were asked to derive a novel theory of osmosis. The test results confirm that they were able to successfully apply the conceptual framework to a new situation under final exam conditions. The marble game thus provides a pathway to the STEM disciplines that includes quantitative biology concepts in the undergraduate curriculum - from the very first class. DUE-0836833 <http://circle4.com/biophysics>.

1100-Pos Board B855

Developing Creative Laboratory Skills through Student Self-Developed Activities

Qing Shao, Joseph D. Ametep.

School of Science and Technology, Georgia Gwinnett College, Lawrenceville, GA, USA.

At Georgia Gwinnett College, the majority of students taking Introductory Physics courses are undergraduates in Biology majors. Creative skills and technical writing abilities are critical in holistic student development and student